SmartState®

ELEVATE

SOUTH CAROLINA | 2015 / 2016 ANNUAL REPORT

CONTENTS

MISSION

The South Carolina SmartState® Program serves the public interest by creating incentives for the state's research universities, in cooperation with other institutions of higher education in the state, to raise capital from non-state sources to fund endowments for specialized research professorships. These professorships in turn serve as the nucleus for unique, university-based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, enhance economic opportunities, and improve the Quality of life for the people of South Carolina.

ELEVATE

SOUTH CAROLINA | **2015 / 2016 ANNUAL REPORT**

A WELCOME FROM THE SMARTSTATE® REVIEW BOARD

The SmartState® Review Board consists of eleven members who serve three-year terms. Three are appointed by the Governor, three are appointed by the President Pro Tempore of the Senate, three are appointed by the Speaker of the House of Representatives, one by the Senate Finance Committee, and one by the Chairperson of the House Ways and Means Committee. The Review Board oversees operations of the SmartState® Program. The presidents of South Carolinas three research universities serve as ex officio, non-voting members.

The SmartState® Program does not receive taxpayer dollars to fund economic development related initiatives to benefit the state; it is funded through revenue generated by the South Carolina Education Lottery, which is then matched dollar-for-dollar by non-state businesses and foundations.

"I have served on the Smart State Review Board since 2008 and I am honored to have been asked to help implement this important program that our legislators and state business leaders created. Today, South Carolina's three research universities are known throughout the world for the 51 research centers of economic excellence they established. The Smart State Program has clearly delivered on its primary mission to generate the high skilled and high wage jobs that our state needs to raise the per capita income of our citizens and improve their quality of life."

REGAN VOIT, CHAIR
Appointed by the Chairman, Senate Finance Committee

"Recognized as one of the best of its kind, the SmartState® Program has created an unprecedented collaboration between businesses and the three research universities to enhance economic opportunities and improve the quality of life for the people of South Carolina, along with attracting world-renown scientists and experts to the state. The SmartState® Program will positively impact South Carolina for years to come and it has been a pleasure and joy for me to be involved with such a positive and impactful program.'

MELVIN C. WILLIAMS, VICE CHAIR
Appointed by the President Pro Tempor, Senate

"The SmartState® Program has enabled our research universities to be more competitive in attracting top talent to our state and there is a significant, tangible benefit to economic development and the quality of life in South Carolina."

CHARLES W. GARNETT
Appointed by the Governor

"It is honor to serve on the SmartState® Review Board, which gives me the opportunity to help promote South Carolina in a competitive economic environment nationwide. The Smart State Program has succeeded in elevating South Carolina's knowledge economy by financially supporting the research universities in recruiting world-class experts for the endowed chairs. Our research universities are important to the state's success through developing cutting edge technologies and bring South Carolina to the front in today's knowledge-based economy."

KAROLY "CHARLES" KEREKES
Appointed by the Governor

"As a small business owner, I see the SmartState® Program as a win for the State of South Carolina, the business community and our citizens. SmartState® is funded by the South Carolina Education Lottery, not by tax dollars. Every dollar invested earns a high rate of return in terms of high-paying job creation, company formation and corporations relocating to our state. It's an investment that keeps giving back."

LISA D. MAIN
Appointed by the Speaker, House of Representatives

"I have served on the SmartState® Review Board for all but a few months of its many-year existence and I could not be more proud of the collective effort of the many board members over the years, our legislative supporters, and the leaders of Clemson, USC and MUSC. The accomplishments have included attracting to South Carolina hundreds of the finest minds in the world to conduct research and help commercialize their successes, and overall to provide the muscle needed for our great state to become a worldwide leader in innovation.

All of us involved with SmartState® helped fuel the expansion of BMW and related automotive research and development companies, and helped convince Boeing to come to South Carolina and then expand, invest and conduct more and more of its worldwide research and development efforts here. The history of success of the South Carolina SmartState® Program is unbelievable and will continue to grow and positively impact many future generations of leaders and business people. Thank you to the vision of the few who have forever impacted the lives of the many!"

ROBERT W. PEARCE, JR.
Appointed by the Speaker, House of Representatives

"The SmartState® Program has truly amplified our three research universities' significant roles in South Carolina's economic development efforts with more than 12,000 high-wage jobs created and a $2.4 billion total impact. This trend seems likely to strengthen as our state's progresses into the era of a true innovation economy. Now with 51 Centers of Excellence operating in six high-tech industry clusters, our universities truly have the leadership to make economic revitalization a continued priority, the culture to mesh that objective with their academic mission, the legal flexibility to mix and match assets and brainpower with the private sector, and the resources to make it all work."

JASON P. PREMO
Appointed by the Governor

"Did anyone imagine how the creation of this program would elevate South Carolina to extraordinary heights in clusters of national and global importance? Some of the best and brightest researchers have joined our state's three research universities as SmartState® Endowed Chairs. Some of the most generous individuals and companies have donated matching dollars to lottery funds. Universities are graduating highly qualified candidates in our cluster fields ... advanced materials, automotive and transportation, biomedical, energy and alternative fuels, information science, and pharmaceuticals ... and employers are hiring them in South Carolina. Universities are collaborating and public-private partnerships have flourished. Now let's start to imagine what could be next!"

ROBERTA BANKHEAD WOOD
Appointed by the Chairman, House Ways & Means Committee

SOUTH CAROLINA'S
SENIOR RESEARCH UNIVERSITIES

Elevating South Carolina Through Research, Innovation and Education

The SmartState® Program funds Centers of Economic Excellence at South Carolina's three senior research universities: Clemson University, the Medical University of South Carolina (MUSC) and the University of South Carolina (USC). Other state universities such as South Carolina State University and the College of Charleston are included as collaborative research partners.

In 2002, members of the South Carolina General Assembly recognized the critical role research universities plays in advancing innovation, creating economic and educational opportunities, and improving overall quality of life for the state's citizens when it acted with foresight and an eye to the future, passing the enabling legislation of the SmartState® Program. Today, other states look to South Carolina's SmartState® Program as the model for university-based public-private partnerships that foster innovation, launch companies and create jobs.

Ranked #23 among national public universities, Clemson is a major land grant, science- and engineering-oriented research university that is an inclusive, student-centered community characterized by high academic standards, a culture of collaboration, school spirit, and a competitive drive to excel. With agricultural and forestry research centers and innovation campuses located from Greenville to Charleston, and a presence in every county, Clemson's campus is truly the entire state of South Carolina. This year, Clemson was classified among universities with the highest level of research activity by the Carnegie Classification for Institutions of Higher Education.

Clemson has launched a new strategic plan, ClemsonForward, which emphasizes high-impact engagement opportunities to prepare students for a knowledge-based global economy, and growing research and doctoral education to help find solutions to real world problems. The plan also supports economic development and creates jobs, enhances quality of life and builds the university's national academic reputation. The plan identifies six innovation clusters to support development of multi-disciplinary teams and large research projects: Health Innovation, Sustainable Environment, Human Resilience, Big Data Science, Complex Engineered Systems, and Advanced Materials.

MUSC has served the citizens of our state since 1824. MUSC has expanded from a small, private college to a comprehensive academic health sciences center, with approximately 1,500 faculty members educating and training more than 3,000 students, residents, and biomedical scientists in six colleges (Dental Medicine, Graduate Studies, Health Professions, Medicine, Nursing, and Pharmacy). As the largest non-federal employer in Charleston, the university and its affiliates have collective annual budgets in excess of $2.2 billion, with an annual economic impact of more than $3.8 billion and research funding in excess of $250 million annually. MUSC Health operates one of the state's largest

CLEMSON UNIVERSITY

MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA

UNIVERSITY OF SOUTH CAROLINA

and most innovative health systems, which includes a nationally recognized Children's Hospital, the Ashley River Tower (cardiovascular, digestive disease, and surgical oncology), Hollings Cancer Center (a National Cancer Institute-designated center), Level I Trauma Center, Institute of Psychiatry, and the state's only transplant center.

Established in 1805, USC is home to more than 200 years of history and tradition, with nearly 50,000 students at its eight campuses across the state. The main campus in Columbia offers 324 degree programs through its 14 colleges and schools, which include medical schools in Columbia and Greenville, and the USC School of Law in Columbia. The Sonoco International Business Department within the Darla Moore School of Business offers an undergraduate international business major that is consistently ranked as #1 by U.S. News & World Report. USC is one of only 32 public universities to receive both the top-tier research designation and the top-tier community engagement designation from the Carnegie Foundation. ●

"The SmartState® Program continues to have a tremendous impact on both Clemson University and the State of South Carolina. The program is a shining example of the power of public-private partnerships, and I know it has made a difference in our ability to recruit and retain faculty members who are regarded nationally among the best in their fields. This, in turn, has boosted Clemson's research profile, allowed us to recruit the best and brightest students from around the country, and has attracted more industry partners to South Carolina."

JAMES P. CLEMENTS, Ph.D.
President
Clemson University

"The SmartState® Program accelerates the opportunity to allow biomedical discovery to become reality for the citizens of South Carolina, and for the advancement of economic development throughout the state. This aligns with MUSC's strategy for the future, Imagine MUSC 2020, which embraces collaboration, drives innovation, and ultimately is fueled by the ability to recruit and retain world-class investigators."

DAVID J. COLE, M.D.
President
Medical University of South Carolina

"Fourteen years after the inception of South Carolina's SmartState® Program, we are pleased to see not only highly productive, successful partnerships between the state's research universities and businesses, but also a new knowledge-based economy that is elevating the Palmetto State through job-creating research in high-growth, high-wage industries. It is gratifying to see the opportunities afforded to our brightest students as they work side-by-side with world-class SmartState® scientists and engineers. Indeed, students participating in these SmartState® Programs will soon be South Carolina's most sought after employees. As new jobs and new federal and private funding continue to come in, nothing elevates South Carolina more than a competitive workforce that begins here at South Carolina's great research universities."

HARRIS PASTIDES, Ph.D.
President
University of South Carolina

GUEST PROFILE

ELEVATING SOUTH CAROLINA

No one understands South Carolina business and government like Ted Pitts.

He joined the South Carolina Chamber of Commerce in 2015 after serving as Governor Nikki Haley's first chief-of-staff. He is a former member of the South Carolina House of Representatives and worked as a partner and commercial real estate broker with Wilson Kibler. Ted is also a major in the South Carolina Army National Guard.

SSP: What makes South Carolina so attractive to businesses?

TP: When businesses look at South Carolina, they see an incredible quality of life. Our friendliness and natural resources set us apart. It also helps that we are the least unionized state in the country; businesses want direct relationships with their employees.

SSP: What big wins have elevated South Carolina over the last 18 months?

TP: Everyone has worked hard to make South Carolina the best state in the country in which to do business, and we have many wins, especially in manufacturing. The first was becoming a work-ready state; Governor Nikki Haley made it a priority. Workforce is the number one factor companies consider when locating to a state. Second, we all know about BMW, but South Carolina has succeeded in becoming an automotive industry world leader. Two of the last ten automotive manufacturing facilities that have come to North America, Volvo and Daimler, were put in South Carolina; the other eight went to Mexico. Third, Boeing continues to expand and now has close to 9,000 employees. Their suppliers have also located here, bringing more jobs.

Finally, we are the tire manufacturer of the world with Michelin North America, Bridgestone, Continental, and GiTi, a Chinese tire maker that recently announced a plant in Chester County.

SSP: Workforce development is a priority for the South Carolina Chamber. What needs to be done to ensure South Carolina stays competitive?

TP: When we talk to Chamber members of all sizes and from all sectors—health care, information technology, insurance, and manufacturing—there's one thing that keeps CEOs up at night: workforce. Our workforce is aging and there's a skills gap. Jobs today are much more technical so people need a higher level of skill. We have to change the way we deliver education and training. We need to continue to expand options to high school students and grow apprenticeship programs. By using the work done by SCDEW on the sector strategies, we can entice students to go into fields where there are jobs.

Recognizing the need for more coordination on the state level, the Chamber and others worked with the General Assembly on House Bill 4145, which creates a public/private Coordinating Council for Workforce Development. The bill passed both Houses June 2, 2016 and Governor Haley signed it into law a week later. What this new council will do is make sure that K-12, university, and technical college education in our state aligns with future workforce needs. South Carolina is also the first state to implement sector strategies, which studied the four regions of the state to evaluate current jobs and what the present and future workforce needs are. It's a forward-looking approach and we've got tremendous momentum.

SSP: What roles do Clemson, MUSC and University of South Carolina "USC" have in attracting and keeping businesses in SC?

TP: Our research universities are a vital driver in education, workforce development and ultimately improving the quality of life for South Carolinians. Clemson has helped elevate two important areas for the state, agribusiness and automotive industries through CU-ICAR. USC has the top Master of International Business program in the nation, and its aerospace, business, information technology, and insurance focuses have a multiplier effect on our economy. MUSC's medical research and innovative telehealth initiatives are nationally recognized and have a real impact on South Carolinians. All three universities are critical to South Carolina's success.

SSP: Where are the largest opportunities for improvement?

TP: South Carolina's infrastructure needs attention and investment. Our main transportation arteries fall behind other states, with bridges in disrepair and growing congestion on our interstates. Fortunately, the General Assembly passed a bill during the 2016 legislative session to improve both. The Port of Charleston is being deepened to accommodate larger cargo ships. We're also focused on improving our information technology infrastructure.

SOUTH CAROLINA CHAMBER of COMMERCE

TED PITTS

President & CEO
South Carolina Chamber of Commerce

SMARTSTATE® PROFILE:
DR. ROBERT BALDWIN

Growing up in Maine, a state historically dependent on forestry and agriculture, Robert Baldwin developed a love of nature and conservation. When given the opportunity to become the Margaret Lloyd SmartState® Chair in the Center for Urban Ecology & Restoration at Clemson University, his answer was a resounding yes.

"South Carolina is like Maine in that it's also a rural state whose backbone is forestry and agriculture; these industries have a $41 billion annual impact on the state's economy. However, South Carolina is transitioning into a more urbanized, high-tech economy. A large part of the attraction for companies like BMW and Boeing is the state's coasts, mountains and forests, which create a wonderful quality of life. Economic growth and job creation are important, but also pose challenges," Baldwin said.

Chief among them is urban sprawl. Spreading from urban cores, strip malls and parking lots dominate landscapes near cities across the country. While necessary, these vestiges of commercial success destroy habitats and lower overall quality of life,. According to Baldwin, the question for South Carolina is one of balance: how do we balance growth with preservation of natural resources.

Baldwin, a conservation biologist and landscape ecologist whose research is supported by the U.S. Environmental Protection Agency, U.S. Forest Service, U.S. Fish and Wildlife Service, National Science Foundation, private conservation foundations, and the forest products industry, has the answer: strategic decision making about land uses.

"Economic and environmental success can go hand-in-hand; however, South Carolina must plan and build for a sustainable future," Baldwin said. "There is incredible value in embedding small conservation lands in urban landscapes; they are good for the economy and good for health. We have done a great job integrating nature into cities, like Reedy River in Greenville. People flock there. But we have not done a great job keeping natural areas near cities. Urban sprawl threatens the natural landscapes that our wonderful cities are embedded in". Natural areas make cities more livable," Baldwin said. "We need more nature where we live and work."

Baldwin's SmartState® Endowed Chair covers these issues. He is working to educate business people, policy makers, land owners, and the public in South Carolina on the value of preserving and protecting the state's unique natural resources like the Congaree Swamp in the Midlands and the Appalachians to the West.

"At the heart of sustainable development is prioritizing decisions on areas to protect from urbanization often through conservation easements. We have to target very carefully and work with landowners," he explained.

Baldwin is using Geographic Information Systems (GIS) to do statistical modeling to determine what areas are most vulnerable. He and his Clemson colleagues are among the first conservation biologists to harness large super computers to solve extensive fine-grain urban ecology spatial problems. Their work will ultimately impact urban centers, forestry, agriculture, and protected natural areas throughout South Carolina.

"We want to ensure South Carolina's natural beauty endures for future generations. We also want happier, healthier communities now. Thanks to the SmartState® Program, Clemson is leading the way," Baldwin said.

> *"South Carolina's population is growing at a rate of six percent a year, attracting people with jobs and natural beauty. We must make a concerted effort to preserve the things that make the state great: its mountains, forests and coasts. People need nature and South Carolina needs a strategy for sustainable development."*

CLEMSON UNIVERSITY

ROBERT BALDWIN, Ph.D.

Margaret Lloyd Endowed Chair
Center for Urban Ecology & Restoration

SMARTSTATE® PROFILE:

DR. CAROL FEGHALI-BOSTWICK

Scleroderma is a mysterious and rare disease for which there is no cure. It causes skin to thicken, compromises internal organ function and eventually leads to death.

Scleroderma is also common in South Carolina, particularly among African-Americans. Many of those with scleroderma live in rural areas, far from specialty medical care and no means of transportation. Thanks to Charlestonian, Kitty Trask Holt, whose death from the disease inspired friends and family to raise $1.3 million in less than eight months to find a cure, MUSC researcher Dr. Carol Feghali-Bostwick is getting close to an answer.

Feghali-Bostwick is a top scleroderma researcher; her interest began in graduate school and she has pursued it with a passion. When the SmartState® Endowed Chair was funded and named in Kitty Trask Holt's honor, Dr. Richard Silver recruited Feghali-Bostwick to MUSC, which is also internationally known for its work in scleroderma research.

Feghali-Bostwick was honored to come to MUSC and highly motivated to make a difference. "Scleroderma has a profound effect on South Carolina. It affects individuals, their families and jobs. People often live in smaller communities with no access to specialty care. Transportation is an issue. Care is expensive," she explained. "What's frustrating is that we don't know what causes it. Data suggest it is likely triggered by environmental factors in people who are more susceptible."

Her determination to find a cure paid off in 2009 while at the University of Pittsburgh. She identified a peptide that showed promise in protecting against fibrosing diseases such as scleroderma. In 2012, Feghali-Bostwick published the findings of her research, which was funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases, part of the National Institutes of Health, in Science and Translational Medicine. The article detailed the peptide, dubbed E4, derived from endostatin, a component of the protein collagen XVIII. Lab tests showed E4 protected against fibrosis, the thickening of the skin and/or internal organs common in scleroderma and idiopathic pulmonary fibrosis.

The discovery was significant because the E4 peptide may possibly be the therapy Kitty Trask Holt and countless others hoped would be found.

"Kitty was never without a smile. She believed that the research accomplished through the SmartState® endowment would someday make an impact on the healing of those like her who struggled with scleroderma."

– ED HOLT

Fast forward to 2016. Feghali-Bostwick is working with iBio, Inc., a leader in plant-based biotechnology, to develop CFB03, which is based on E4 to combat fibrosis. She and iBio are working with the FDA to get approval for Phase 1 clinical trials of the drug, which are required to prove safety. If all goes well, Phase 2 trials for efficacy will follow.

Feghali-Bostwick admits they are proceeding cautiously and says she is not "counting her chickens before they hatch." Still, her enthusiasm is obvious. "Our goal is to develop therapies that will prevent or reverse fibrosis and preserve organ function in people with scleroderma and other diseases. I am keeping my fingers crossed."

> *"There is no cure for scleroderma, a rare, often fatal disease that is common in South Carolina. We're awaiting FDA approval to conduct clinical trials of our drug, which has shown promise in improving fibrosis in human tissues. We can't count our chickens before they hatch, but we're very hopeful."*

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

CAROL FEGHALI-BOSTWICK, Ph.D.

Kitty Trask Holt Endowed Chair for Scleroderma Research
SmartState® Center for Inflammation & Fibrosis Research

SMARTSTATE® PROGRAM:
RETURN ON INVESTMENT

The primary mission of the SmartState® Program is to elevate the state's knowledge economy by generating high-skilled, high-wage jobs in South Carolina.

The SmartState® Program's established research centers help elevate the state's knowledge economy by creating public-private partnerships, supporting start-up firms, and helping to retain highly skilled workers. Each of these efforts results in the creation of jobs that are among the highest paid in South Carolina.

Following the 2008 recession, geographic regions with the highest rates of economic growth have typically had higher shares of their workforce employed in the knowledge economy. The skills associated with these jobs often include more advanced training in the fields of mathematics and science, complex problem solving, and creative and technological innovation. The commercialization of new technologies leads to economic growth and significant knowledge spillover effects.

As of 2016, the SmartState® Program is responsible for helping to create and support approximately 12,483 jobs in South Carolina, which are associated with $2.4 billion in economic activity and $669 million in labor income for South Carolinians that would not exist otherwise. Approximately 5,081 of these positions are knowledge economy jobs created directly through the SmartState® Program, with the 7,402 arising from additional spending activity generated through the economic multiplier effect.

The specific employment multiplier associated with these estimates is 2.5—for every ten knowledge economy jobs created through the SmartState® Program, an additional 15 jobs are created elsewhere in South Carolina. This multiplier effect is larger than the state average. Each new job created through the SmartState® Program increased total South Carolina employment by more than it would if that job had been created in another industry of comparable size.

The average annual salary associated with a SmartState® job is $70,803, roughly 78 percent higher than the average annual salary among all jobs in South Carolina. When examining the salaries of all jobs associated with the SmartState® Program, including those created through the economic multiplier effect, the average annual salary is estimated at $53,610. This dollar amount is approximately 34 percent higher than the average annual salary among all South Carolina jobs.

"One of the driving forces behind regions in the United States that have experienced high-wage job creation in the 21st century is the presence of a strong and vibrant knowledge economy. Since 2002, the SmartState® Program has helped facilitate the development of South Carolina's knowledge economy, and in the process, has generated more than 12,000 jobs with annual salaries that pay significantly above the state average."

DR. JOSEPH VON NESSEN
Research Economist
Darla Moore School of Business, University of South Carolina

"As of 2016, the SmartState® Program is responsible for helping to create and support approximately 12,483 jobs in South Carolina, which is associated with over $2.4 billion in economic activity and $669 million in labor income for South Carolinians that would not exist otherwise."

DR. JOSEPH VON NESSEN
Research Economist
Darla Moore School of Business, University of South Carolina

3
Research Universities
Clemson, MUSC, USC

6
Industry Clusters[1]

51
SmartState® Centers of Economic Excellence

66
SmartState® Endowed Chairs appointed
(of the 85 created)

$197.6M
State Funds Invested[2]

$2.4B
Return on Investment[3]

12,483
Total Employment (All jobs)[3]

$70,803
Average Salary of a Knowledge Economy Job[3]

67
Start-ups and Corporate Relocations[4]

1 Industry-focused research is conducted in six areas of global importance: Advanced Materials and Nanotechnology, Automotive and Transportation, Biomedical, Energy, Information Science, and Pharmaceutical.

2 Includes $180 million from the State Education Lottery appropriations and $17.6 million accrued interest from SmartState® Program endowment.

3 The figures reported are from the November 2016 Economic Impact of the SmartState® Program analysis conducted by the Darla Moore School of Business. Of the total 12,483 jobs, 5,081 are knowledge economy jobs created directly through the SmartState® Program, including 597 SmartState® personnel, 1,287 start-up company and corporate relocation personnel, 20 alumni placed with in-state employers, and 3,177 employed through Extramural Research Funding. The remaining 7,402 jobs are indirect employment arising from the economic multiplier effect. For more information about the return on investment, see page 12.

4 See page 14 for a listing of investors, start-ups and corporate relocations.

Investors, Start-ups, and Corporate Relocations in SC

CORPORATE AND ORGANIZATIONAL INVESTORS

More than three dozen companies have invested $500,000 or more in the SmartState® Program.

- Abney Foundation
- BASF
- Bank of America Foundation
- Biomass Gas & Electric
- BlueCross BlueShield Foundation of SC
- BMW
- Comporium Group
- Daniel Island Company
- Dialysis Clinics, Inc.
- Duke Energy Foundation
- Electric Cooperatives of South Carolina
- Fluor Corporation
- Force Protection Industries
- General Atomics
- George B. Sibert Annuity
- GlaxoSmithKline
- Greenville Hospital System
- Health Sciences South Carolina
- J.E. Sirrine Foundation
- Kellogg Foundation
- Kentwool
- Michelin
- Okuma
- Palmetto Health
- PalmettoNet
- Research to Prevent Blindness
- Robert Wood Johnson Foundation
- Samuel Freeman / Donaldson Charitable Trust
- Santee Cooper
- Smith & Nephew
- Spartanburg Regional Healthcare System
- The Duke Endowment
- The Spaulding Paolozzi Foundation
- Timken
- Toyota
- Westinghouse

START-UP COMPANIES

Start-up companies that were founded as a result of research at USC, MUSC, and Clemson University:

- Advanced Photonic Crystals
- Cephos
- DF Werke, LLC
- Doxy.me
- Fibro Therapeutics, Inc.
- First String Research
- GeoMat, LLC
- Hydrogen Hybrid Mobility, LLC
- ImmoMod, Inc.
- Inquisatex Epitherapeutics, LLC
- IntrusinMyFamily.com
- MagAssemble, LLC
- MicroVide
- MitoChem Therapeutics, LLC
- MitoHealth
- NextGenEn
- NXT
- Palmetto Fuel Cell Technologies, LLC
- Parallel Permeation, Inc.
- Patient Guided Health Solutions, LLC
- Perfect Mixing, LLC
- Protara, LLC
- SAGE Energy Solutions
- Schnellgen, Inc.
- SemiAllogen, Inc
- SimTunes, LLC
- Smart Innovations, LLC
- South Carolina Science Solutions, LLC
- Specialty & Custom Fibers, Inc.
- Tetramer Technologies
- Vortex Biotechnology
- Zeriscope, Inc.
- 52 Inc.

CORPORATE RELOCATIONS

Companies that have relocated to South Carolina to take advantage of the expertise, resources, and graduates in the SmartState® Program:

- American Titanium Works (ATW) Manufacturing
- American Titanium Works (ATW) Technology Center
- BMW Information Technology Research Center (ITRC)
- CADFEM U.S.*
- Charge2Target
- CleanEnergy
- COE Optics
- Computech*
- Cooliemon Technologies*
- DreamWeaver*
- EHD Tech
- Environment and Health Inc. (EHG)
- Esys Automation
- Fields Group, LLC.*
- Focus Chemicals*
- Greenway Energy, LLC
- Innoventure
- IndySoft
- Intec U.S. Inc.
- JTEKT Technology Center
- Mallet Technology*
- Michelin
- Michelin Incubator
- Mumford Industries*
- OmniSource
- Proterra, Inc.
- Roding*
- Sage Automotive Interiors*
- Senex Biotechonology, Inc.
- Simpack, Inc.
- ThermoPur Technologies*
- Toho Tenax*
- Tigges*
- Trulite

* In May 2012, CU-ICAR (Clemson University International Center for Automotive Research) opened the doors to the Center for Emerging Technologies (CET) facility, its first multi-tenant building. CET provides office, administrative, and laboratory space for transportation, technology, and energy sectors. These companies have positioned themselves on the CU-ICAR campus to be close to the SmartState® Endowed Chairs and their research teams.

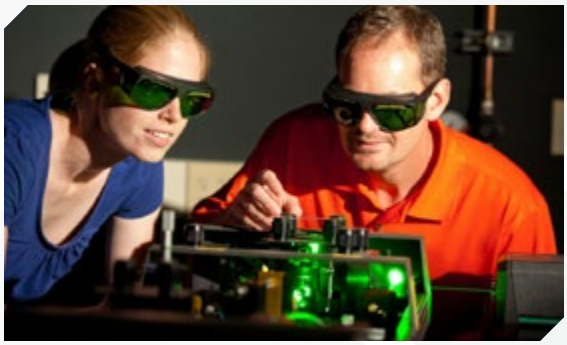
ELEVATING SCIENCE:
SCIENCE CAFÉ COMES TO THE UPSTATE

The SmartState® Program is an economy-building, quality of life-enhancing program for the people of South Carolina that is brought to life by Science Cafés. These events, which are now held in Columbia, Charleston and the Upstate, are informal gatherings that feature a SmartState® Endowed Chair, an inquisitive audience and lively discussion. Science Café is fun, engaging, and elevates the SmartState® Program by sharing the incredible science and technology with all interested parties.

The goal of the Science Café series is to educate the public about ongoing research conducted by SmartState® Endowed Chairs at Clemson University, the Medical University of South Carolina (MUSC) and University of South Carolina and how it benefits South Carolinians. From the initial Science Café in Columbia, the state now boasts three such chapters of the global science phenomenon. In 2015, MUSC launched its Science Café, and now in 2016,the Upstate has one too.

Kicking off the Upstate's inaugural Science Café, held September 20 at the NEXT Innovation Center in Greenville, was Clemson's Dr. John Ballato, the SmartState® Endowed Chair in Optical Materials and Photonics. Ballato is one of those smart guys; make that one of those super-smart guys. In addition to his SmartState® Endowed Chair, he is a professor of Materials Science and Engineering and director of the Center for Optical Materials Science and Engineering Technologies (COMSET).

Ballato holds 25 patents and has served as the principal investigator on more than $34 million in sponsored research projects. His focus is new optical materials and structures for high-value photonic and optoelectronic applications, including light-emitting nanoparticles for transparent ceramics, lighting and sensing applications. Additionally, his research group develops specialty optical fibers for high-energy laser, biomedical and industrial uses.



Clemson University's Dr. John Ballato, the SmartState® Endowed Chair in Optical Materials and Photonics

SCIENCE CAFE

Nearly 35 people showed up to learn more about Ballato's research and enjoy refreshments provided by SmartState® Review Board member Jason Premo of Premo Ventures. The discussion revealed South Carolina's legacy and contributions in the field of light and wide-ranging applications, which include everything from industrial lasers to U.S. weapons systems. He also shared that Greenville native and Nobel Prize winner, Dr. Charles Townes, is considered the premier innovator of lasers used by industries around the world.

"Science Café Upstate is a great way to indulge the public's curiosity about the important work being done by SmartState® Endowed Chairs," Premo said. "It's knowledge one would never get from daily life." ●

> *"We deliberately created Science Café Upstate to be inclusive of the entire region. So many wonderful things are happening in Clemson, Greenville and Spartanburg. The more we collaborate, the more we benefit."*
>
> – **ROBERTA BANKHEAD WOOD**, *SmartState® Review Board Member*

SMARTSTATE® PROFILE:

DR. LAURA B. CARDINAL

The SmartState® Program's new Endowed Chair for Innovation and Commercialization, Laura B. Cardinal, smiles when asked how she became interested in company formation.

"My father was an upwardly mobile business executive and I grew up reading The Wall Street Journal. I was taught to be creative, take risks and color outside the lines."

She adds, "Later I discovered a love of organizations, particularly startup companies, and what makes them successful. Company formation and bringing products to market are not linear processes. If you're missing a piece of the puzzle, you fail. It's messy, fun and complex."

Cardinal, who describes herself as an innovation person who also does entrepreneurship, earned a Ph.D. in Organizational Studies from the University of Texas-Austin where she was a National Science Foundation grant recipient. Her expertise in managing innovation and R&D capabilities, understanding the evolution of founding companies and control systems within those companies led to faculty positions at the University of Houston, Tulane University, University of North Carolina-Chapel Hill, Duke University, and Southern Methodist University. Along the way, she consulted with corporations, published a book, Organizational Control, and serves on the Academy of Management's Board of Governors and other prestigious industry organizations.

Despite a hectic schedule, Cardinal's life was under control when the University of South Carolina (USC) offered her the SmartState® Endowed Chair within the newly created Center for Innovation and Commercialization. Despite she and her husband having just purchased a home, Cardinal jumped at the offer. "To become a SmartState® Chair at USC and within the Darla Moore School of Business was a once in a lifetime opportunity and too good to pass up," she said.

A passionate advocate for technology born of university research, Cardinal says universities like USC are a rich source of technology and powerful economic drivers. She is quick to point out that success doesn't happen overnight; universities need champions in government and business to reach their full potential. She points to the University of Texas-Austin as a prime example.

"Once upon a time, Austin was a sleepy college town with very few jobs outside of flipping hamburgers. UT served as a catalyst for entrepreneurial activity and growing talent for Dell, IBM and other Austin-area "Silicon Hills" businesses. Close partnership with state and local governments led to formation of key incubators and alliances for tech development. This caused people to want to live in Austin and be part of dynamic tech environment."

Cardinal believes South Carolina is well on its way to similar success, crediting the SmartState® Program and the willingness of the state's three largest research universities to collaborate with business and each other and commit resources to initiatives like her SmartState® Center, which is dedicated to advancing university innovation and technology commercialization.

"It's an exciting time to be in South Carolina. We have major companies like IBM, Boeing and BMW that have chosen to be here. We have universities that are climbing in national rankings. The world is looking at us and recognizing it's a great place for business, innovation and technology."

> *"University research and knowledge are economic engines. Entire industries and states have benefited from university research. Look at the pharmaceutical industry. Look at North Carolina's Research Triangle. Look at Austin, Texas. Successful, active research universities are at the core. We live in a world of disruptive technology and demand for innovation will only continue to grow."*

UNIVERSITY OF SOUTH CAROLINA

LAURA B. CARDINAL, Ph.D.

SmartState® Endowed Chair
SmartState® Center for Innovation and Commercialization

SMARTSTATE® PROFILE:
DR. MAREK URBAN

Even when Clemson's Marek Urban is deep in his work at the Advanced Materials Research Laboratory at the Clemson University Center for Optical Materials Science and Engineering Technologies (COMSET), his mind always goes back to nature.

Specifically, the way reptiles, fish, and even plants change color in response to stimuli in order to survive.

A color-shifting chameleon seems far removed from Urban and his interdisciplinary research group that explores a broad range of fundamental and applied aspects of materials chemistry in general, and macromolecular science in particular. The connection is very real and Urban is an expert on the topic; he is the author of Stimuli-Responsive Materials: From Molecules to Nature, Mimicking Materials Design.

"The ability for a material to change properties in response to external stimuli is an attractive feature for numerous applications, and as such, stimuli responsive materials are gaining attention across many different fields," Urban said. "My book introduces the concepts of stimuli-responsiveness, including the fundamental materials properties required for design, the science of stimuli responsive materials, as well as recent technological advances."

Many of those advances are from Urban's lab, which focuses on four areas of research: heterogenous radial polymerization, bio-active polymeric surfaces and interfaces, encoding stimuli responsiveness in materials, and self-repairing materials.

Among Urban's projects is encoding stimuli responsiveness into materials so they automatically respond to environmental factors. One example is a polymer stent that reacts to heat so that when implanted in a human artery, it expands with the body's heat, opening a blockage. These dynamic stents could replace rigid metal stents.

Urban is also encoding new molecules into existing polymers to create self-repairing polymer systems with various performance attributes such as with light sensitivity, corrosion inhibition and anti-fouling. These materials actually heal themselves when damaged or torn through electromagnetic radiation or a chemically induced reaction. Imagine a damaged space station that must heal itself in orbit rather than rely on human intervention.

Another area of research is bio-active polymeric surfaces and interfaces with potential biomedical applications such as anti-microbial and antibiotic infection control. Health care, pharmaceutical, food and beverage producers, schools – any industry where sterility and hygiene are critical could benefit from such materials.

Urban admits most people don't understand his work as the focus is not immediate commercialization. Instead, he explains, "We are exploring the frontiers of technology in hopes of revolutionizing the world."

Some frontiers are closer than others. The aerospace industry is interested in self-heating polymers and composite materials that could extend the lifetime of a jetliner. Such novel materials must meet stringent requirements for safety and performance in extreme environments. The National Science Foundation and U.S. Department of Energy have provided funding for futuristic color-changing, self-healing material and sensors that are sensitive to humidity changes in buildings and rely on built-in chemical energy systems.

"We have an entirely different way of thinking; one with an eye on nature and the future," Urban said.

> *"We are breaking ground for an entirely new generation of stimuli-responsive polymer materials. These transformative technologies are futuristic by design and in high demand by forward-thinking industry leaders in aviation, automotive and biomedical industries that see the potential of advancing performance and sustainability through science."*

CLEMSON UNIVERSITY

MAREK URBAN, Ph.D.

J.E. Sirrine Foundation Endowed Chair
SmartState® Center for Advanced Fiber Materials

SMARTSTATE®

CENTERS AND ENDOWED CHAIRS

The work of South Carolina's SmartState® Centers is exciting, groundbreaking, and of critical importance to the state, nation and world. These Centers, which align with industries in South Carolina, help elevate the state's economy and quality of life. What follows is an overview of each Center.

Program totals reported as of November 2016. In cases of joint proposals, Centers awarded by an institution are tallied by the fiscal agent. Endowed chairs are tallied based on the assigned institution. USC's assigned endowed chairs include one joint appointment with MUSC. On the pages that follow, information about each SmartState® Center includes the date the Center was approved, the institution(s) awarded, the state award amount that must be matched with an equal amount of non-state investment, the appointed endowed chair(s) as of November 2016, reported extramural research funding (federal and private awards) above the match, and a brief description of the research focus. Centers are grouped by industry cluster. For updated information on Centers and program totals, contact the S.C. Commission on Higher Education or visit SmartStateSC.org.

51 SmartState® Program Centers Awarded

85 SmartState® Endowed Chairs Created

66 SmartState® Endowed Chairs Appointed

19 SmartState® Endowed Chairs Remaining to be Appointed

	CLEMSON UNIVERSITY	UNIVERSITY OF SOUTH CAROLINA	MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA
	13	**18**	**20**
	16	**28**	**41**
	12	**22**	**32**
	4	**6**	**9**

ADVANCED MATERIALS & NANOTECHNOLOGY

ADVANCED FIBER-BASED MATERIALS*

Award Date: 2006

State Award Amount: $4 million

University: Clemson

Endowed Chair(s):
Dr. Marek Urban
J.E. Sirrine Foundation Endowed Chair in Advanced Fiber-Based Materials

Corporate Partner(s):
J.E. Sirrine Textile Foundation

External Funding Above Match:
$10.5 million

Research Focus: To provide the vehicle for repositioning existing manufacturing resources to support new industry opportunities based on advanced fiber-based products.

ENVIRONMENTAL NANOSCIENCE AND RISK

Award Date: 2008

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. Jamie Lead

External Funding Above Match:
$1.6 million

Research Focus: Understand the fundamental properties of nanomaterials and nanomaterials-environment interaction and use these principles to understand and help reduce impacts of nanomaterals as used as well as develop and innovate nanotechnological applications.

EXPERIMENTAL NANOSCALE PHYSICS*

Award Date: 2003

State Award Amount: $4 million

University: USC

Endowed Chair(s):
USC is recruiting one endowed chair.

External Funding Above Match:
$5.1 million

Research Focus: Perform basic and applied research of potential spintronic optoelectronic and nanoelectronic devices and/or materials for future applications in information processing, high-speed, high-density electronics, and bio, chemical and radiation sensing.

MULTIFUNCTIONAL MATERIALS & STRUCTURES (MFMS)

Award Date: 2013

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Michael van Tooren

Research Focus: The development and supply of engineered materials for high technology industries such as aerospace by providing a foundation of research and development that will enable and enhance growth in the engineered materials field. Specific examples of research and development include: Lightning strike and EMF management, structural integrity, energy storage, essential power for commercial aircraft, and multi-physics-based micro/nano mechanics of dielectric materials.

OPTICAL MATERIALS/PHOTONICS*

Award Date: 2004

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. John Ballato
J. E. Sirrine Textile Foundation Endowed Chair in Optical Fiber

Corporate Partner(s):
J.E. Sirrine Textile Foundation

External Funding Above Match:
$21.7 million

Research Focus: Conduct materials research and recruit and mentor graduate students with a focus on domestic scholars. Identify and foster the latest technologies and initiate partnerships with top national research universities and laboratories, Aid South Carolina industry and economic development partners in the transfer of technology from Clemson to the public sector, and participate in the recruitment of optical technology firms to South Carolina.

POLYMER NANOCOMPOSITES*

Award Date: 2004

State Award Amount: $3.5 million

University: USC

Endowed Chair(s):
Dr. Brian Benicewicz
Materials Science & Engineering

Corporate Partner(s):
Michelin North American, BASF, U.S. Navy, PBI Performance Products

External Funding Above Match:
$12.2 million

Research Focus: Development of synthetic tools needed to precisely control the environment or interface between nanoparticles and polymer matrix applicable to optics, electronics, biological, medical, and structural material applications.

* Graduated Center

AUTOMOTIVE & TRANSPORTATION

AUTOMOTIVE DESIGN AND DEVELOPMENT*

Award Date: 2004

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. Zoran Filipi
Timken Endowed Chair in Automotive Design & Development

Corporate Partner(s):
Hertz Corporation, Duke Energy

External Funding Above Match:
$5.9 million

Research Focus: Focuses on the research and design of advanced powertrains for internal combustion engines and hybrid and electric vehicles, along with lightweight design and materials, functional integration and structural dynamics for vehicles.

AUTOMOTIVE MANUFACTURING*

Award Date: 2003

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. Laine Mears
BMW Endowed Chair in Automotive Manufacturing

Corporate Partner(s):
BMW

External Funding Above Match:
$7.9 million

Research Focus: Develops micro-electromechanical systems technologies for manufacturing and improving the efficiency of manufacturing large, complex objects. The goal is for the Center to be the premier automotive and motorsports research and educational facility in the world.

AUTOMOTIVE SYSTEMS INTEGRATION*

Award Date: 2003

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting the *BMW Endowed Chair in Automotive Systems Integration.*

Corporate Partner(s): BMW, Mazda, GM and others

External Funding Above Match:
$3.7 million

Research Focus: Automotive diagnostics and prognostics, sustainable mobility, concepts, methods and tools. Deriving a simple, flexible energy management control strategy for plug-in hybrid electric vehicles.

SUPPLY CHAIN OPTIMIZATION AND LOGISTICS*

Award Date: 2006

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Dr. Scott Mason
Fluor Endowed Chair in Supply Chain Optimization & Logistics

Corporate Partner(s): Fluor

External Funding Above Match:
$10.3 million

Research Focus: Interdisciplinary research addressing the multifaceted problems associated with supply chains. Deliver tangible supply chain optimization and logistics products and services through theoretical and applied research.

VEHICLE ELECTRONIC SYSTEMS INTEGRATION*

Award Date: 2004

State Award Amount: $3 million

University: Clemson

Endowed Chair(s):
Dr. Venkat Krovi
Michelin Endowed Chair in Vehicle Electronic Systems Integration

Corporate Partner(s):
Michelin

External Funding Above Match:
$1.7 million

Research Focus: Research in automotive and vehicular electronics, particularly systems integration issues, electromagnetic compatibility and electromagnetic modeling.

* Graduated Center

Once a Center has reached a point of full operability, the SmartState Review Board has the authority to graduate SmartState Centers. A Center must meet the requirements in the following key areas to be considered graduated: non-state match; all drawn downs; endowed chairs and key personnel; initiatory programmatic activities have been achieved; the most recent annual report cites demonstrable programmatic activity; and match certification. Once a center is graduated, the majority of fiscal and administrative oversight responsibilities is transferred to the Center's lead fiscal institution. Certain accountability and reporting obligation will be retained by the graduated Center.

BIOMEDICAL

ADVANCED TISSUE BIOFABRICATION

Award Date: 2008

State Award Amount: $5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):
MUSC, USC, and Clemson are recruiting Endowed Chairs in *Biofabrication Biology* and *Biofabrication Engineering.*

Research Focus: Develop innovative technologies and approaches that will enable repair, replacement, or restoration of diseased cells, tissues and organs.

BRAIN IMAGING

Award Date: 2003

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):
Dr. Chris Rorden, USC

Dr. Joseph Helpern, MUSC

MUSC is recruiting one additional endowed chair.

External Funding Above Match:
$27.4 million

Research Focus: Creating a world-class brain imaging center. Initiated the first study using transcranial magnetic stimulation (TMS). Combined with functional MRI, TMS provides a short strong magnetic field useful for studying how the brain works. Specific studies include stroke-related brain injury and MRI physics techniques for clinical and neuroscience research.

CHILDHOOD NEUROTHERAPEUTICS

Award Date: 2006

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):
Dr. Jeffrey Twiss, USC
Child and Adolescent Neurochemistry

Dr. Manuel Casanova, USC
Translational Clinical Research

USC is recruiting one endowed chair in *Translational Clinical Research.*

MUSC is recruiting one endowed chair in *Neurodevelopmental Disorders.*

External Funding Above Match:
$7.2 million

Research Focus: Prevention of brain damage in premature infants and curing infant brain diseases through cellular engineering. Also working on cognitive behavioral tasks in transgenic mice to determine if therapeutics can improve functional development outcomes, which may someday help children with ADHD.

CLINICAL EFFECTIVENESS AND PATIENT SAFETY

Award Date: 2006

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):
Dr. John Schaefer, MUSC
Lewis Blackman Endowed Chair for Patient Simulation & Research for Health Sciences South Carolina

Dr. Jihad Obeid, MUSC
Biomedical Informatics

USC is recruiting one endowed chair.

External Funding Above Match:
$12.1 million

Research Focus: Quality and safety of patient care, and improving the medical informatics aspects of data acquisition and the evaluation of health information technology on the quality and safety of clinical care processes and outcomes. The Center also focuses on developing South Carolina as a training center for physicians and other health professions using human simulators and sophisticated software-based training scenarios.

EFFECTIVENESS RESEARCH IN ORTHOPEDICS (CERotho)

Award Date: 2007

State Award Amount: $5 million

University: USC

Endowed Chair(s):
Dr. John Brooks

Corporate Partner(s):
Smith & Nephew

External Funding Above Match:
$15.2 million

Research Focus: Medical health needs in orthopaedic disorders, exercise and sports-related injury prevention, treatment, and rehabilitation. The Center investigates the biologics of tissue-engineered materials and implantable devices to find solutions to musculoskeletal maladies.

BIOMEDICAL

HEALTHCARE QUALITY*

Award Date: 2007

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):
Dr. Les Lenert, MUSC
Medical Bioinformatics

Dr. Xiaoming Li, USC
Translational Clinical Research

Corporate Partner(s):
The Duke Endowment

External Funding Above Match:
$18.3 million

Research Focus: Creating a unique and comprehensive clinical data store that collects data from providers, enhances data usability, and makes it available in an easily accessible form for participants to use for clinical improvement and research purposes.

HEALTH FACILITIES DESIGN AND TESTING

Award Date: 2007

State Award Amount: $2 million

University: Clemson, MUSC

Endowed Chair(s):
Dr. Anjali Joseph, Clemson
Architecture & Health Research

Dr. Kenneth Catchpole, MUSC
Clinical Practice and Human Factors

External Funding Above Match:
$1.4 million

Research Focus: The impact of health facility design on health and healthcare delivery and the creation of architectural settings that provide better support for the health, safety, and wellbeing of patients and staff.

INFLAMMATION AND FIBROSIS RESEARCH

Award Date: 2010

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):
Dr. Carol Feghali-Bostwick
Kitty Trask Holt Endowed Chair for Scleroderma Diseases

Dr. Betty Tsao
Inflammation Research

External Funding Above Match:
$14.2 million

Research Focus: Develop new therapies and education programs for inflammatory and fibrosing rheumatic diseases such as lupus, scleroderma, and rheumatoid arthritis.

MARINE GENOMICS

Award Date: 2003

State Award Amount: $4 million

Universities: MUSC, College of Charleston

Endowed Chair(s):
Dr. Gavin Naylor, MUSC
Bioinformatics

MUSC is recruiting one endowed chair.

External Funding Above Match:
$8.9 million

Research Focus: Monitoring and predicting the impact of environmental changes on marine biosystems, which can, in turn, affect human health. Specific areas of study include environmental causation in wildlife, human disease and susceptibility, and mapping variability in genomes and populations; as well as research of shark and ray species.

MOLECULAR PROTEOMICS IN CARDIOVASCULAR DISEASE AND PREVENTION

Award Date: 2006

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):
Dr. Sheldon E. Litwin
Countess Alicia Spaulding Palozzi Chair in Cardiovascular Imaging

Dr. Thomas G. DiSalvo
Volpe SmartState® Endowed Chair in Cardiovascular Biomarker Development for Diagnosis & Prevention

External Funding Above Match:
$4.5 million

Research Focus: Translation advances in basic bench science to clinical bedside care to improve the health care of the citizens of South Carolina. Priorities include diagnostic techniques, therapeutic management strategies, relations of protein signatures to clinical outcomes for risk assessment, and treatment of disease manifestation.

NEUROSCIENCES

Award Date: 2003

State Award Amount: $3 million

University: MUSC

Endowed Chair(s):
Dr. Christopher Cowan
William E. Murray Endowed Chair in Neuroscience

MUSC is recruiting the *Josephine Tucker Morse Endowed Chair in Parkinson's Disease*.

External Funding Above Match:
$14.5 million

Research Focus: Brain neuromodulatory systems and their roles in cognitive performance, drug abuse, sleep and affective disorders. Other areas of research are movement disorders such as Ataxia, Choro, Bradykinesia and multiple system atrophy.

* Graduated Center

BIOMEDICAL

PROSTATE CANCER DISPARITIES

Award Date: 2008

State Award Amount: $3.6 million

University: MUSC, USC, SCSU

Endowed Chair(s):

Dr. Chanita Hughes-Halbert, MUSC
AT&T Distinguished Endowed Chair in Cancer Equity in Cancer Disparities

MUSC and USC are each recruiting one endowed chair in *Cancer Disparities*.

Corporate Partner(s): AT&T Foundation

External Funding Above Match:
$32.5 million

Research Focus: Facilitate statewide partnerships in cancer prevention and control research, clinical trials, and training to significantly decrease disparities in prostate cancer incidence and mortality in South Carolina.

PROTEOMICS

Award Date: 2003

State Award Amount: $4 million

University: MUSC

Endowed Chair(s):

Dr. Richard Drake

Dr. Anand S. Mehta

External Funding Above Match:
$21.5 million

Research Focus: Develop and use high-end analytical technologies to understand the biologic profile of protein expression in health and disease. Developing enzyme-based analytical methods to effectively detect biomolecules in tissues and tissue microarray platforms.

REGENERATIVE MEDICINE

Award Date: 2004

State Award Amount: $5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):

Dr. Martin Morad, USC
BlueCross BlueShield of SC Foundation Chair in Cardiovascular Health

Dr. Stephen Duncan, MUSC
Regenerative Medicine and Cell Biology

Dr. Jeremy Gilbert, Clemson
Hansjörg Wyss Endowed Chair in Bioengineering

External Funding Above Match:
$40.6 million

Research Focus: Regenerative medicine approach for cardiovascular applications and provide expertise in clinical trials, statistics and/or assay development. Application of regenerative medicine and tissue engineering approaches to orthopaedic and neural diseases. Regeneration of tissue and organs for repairing, replacing, and maintaining organ function.

RENAL DISEASE BIOMARKERS

Award Date: 2008

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Deepak Nihalani
Renal Biomarkers

MUSC is recruiting one endowed chair in *Translational Nephrology Research*.

External Funding Above Match:
$4.7 million

Research Focus: Identifying biomarkers that identify or predict prognosis for acute kidney injury, diabetic neuropathy, lupus nephritis, and focal segmental alomerulosclerosis.

SENIORSMART®

Award Date: 2007

State Award Amount: $5 million

Universities: USC, Clemson

Endowed Chair(s):

Dr. Sue Levkoff, USC
SmartHOME®

Dr. Julius Fridriksson, USC
SmartBRAIN™

Clemson is recruiting one endowed chair in *SmartWHEELS™*.

External Funding Above Match:
$7.3 million

Research Focus: Three areas of research include: *SmartBRAIN™* (maintaining intellectual activity), *SmartWHEELS™* (independent mobility outside the home) and *SmartHOME®* (independent mobility inside the home) to foster independent living among seniors.

BIOMEDICAL

STROKE*

Award Date: 2007

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Robert Adams, MUSC
Stroke

Dr. Mark Chimowitz, MUSC
Countess Alicia Paolozzi Endowed Chair in Translational Neurology

Dr. Souvik Sen, USC
Clinical Neurology

External Funding Above Match:
$19.5 million

Research Focus: Enhancing stroke treatment, prevention, and recovery. This Center is developing new stroke-related therapeutics, drug discovery, and biotechnology, and is a leader in stroke telemedicine.

TECHNOLOGY CENTER TO ENHANCE HEALTHFUL LIFESTYLES*

Award Date: 2009

State Award Amount: $3 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Frank Trieber, MUSC
Technology Applications for Disease Prevention, Management, and Risk Reduction

Dr. Delia West, USC
Technology Application for Health Behavior Change

External Funding Above Match:
$13.6

Research Focus: Develop and test lifestyle interventions for improving health, preventing illness and managing chronic health problems caused by physical inactivity, poor diets, and other lifestyle behaviors.

TOBACCO-RELATED MALIGNANCY

Award Date: 2007

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Nancy DeMore
BMW Chair in Cancer Research

MUSC is recruiting the *Burtschy Family Distinguished Endowed Chair in Lung Cancer Research.*

Corporate Partner(s):
BMW

External Funding Above Match:
$52.1 million

Research Focus: Devoted to discovering tobacco-related malignancy biomarkers via clinical trials with a specific focus on tobacco-related cancers. Additionally, the Center is evaluating the specificity and sensitivity of novel biomarkers by molecular epidemiologic techniques across the diverse populations of South Carolina.

TRANSLATIONAL BIOMEDICAL INFORMATICS

Award Date: 2013

State Award Amount: $2 million

University: MUSC

Endowed Chair(s):

Dr. Stephane Meystre

Research Focus: The new Center will provide expertise in translational biomedical informatics essential for cutting-edge, innovative methodologies to link genetic/genomic data with vast amounts of clinical data. The contributions of the center to data sharing/analysis will decrease cost and increase efficiency in research and healthcare delivery and provide a robust IT platform for industry partnerships and new company formation.

URBAN ECOLOGY AND RESTORATION

Award Date: 2006

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):

Dr. Robert F. Baldwin
Margaret H. Lloyd SmartState Chair in Urban Ecology

External Funding Above Match:
$6.4 million

Research Focus: Applied research in environmental science and engineering, habitat restoration and water quality management; environmental industry growth; and urban ecology projects in South Carolina.

VISION SCIENCE

Award Date: 2005

State Award Amount: $4.5 million

Universities: MUSC

Endowed Chair(s):

Dr. Baerbel Rohrer
Chair in Gene and Pharmaceutical treatment of Retinal Degenerative Diseases

MUSC is recruiting one endowed chair.

Corporate Partner(s):
Alcon Labs, Taligen, Alexion Pharmaceuticals

External Funding Above Match:
$21.8 million

Research Focus: New treatments for macular degeneration, development of new anti-glaucoma agents and innovations in cataract surgery. The Center also focuses on using advances in bioengineering and material sciences to improve the diagnosis, treatment, and prevention of eye diseases.

* Graduated Center

ENERGY & ALTERNATIVE FUELS

CATALYSIS FOR RENEWABLE FUELS*

Award Date: 2005

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. John Regalbuto

External Funding Above Match:
$9.2 million

Research Focus: Developing catalysts that allow production of alternative fuels from renewable sources, thereby reducing dependence on imported oil and carbon fuel. The Center focuses on synthesizing inorganic catalysts for converting biomass to biofuels and synthesizing electrocatalysts for solar fuels and fuel cells.

GENERAL ATOMICS CENTER FOR THE DEVELOPMENT OF TRANSLATIONAL NUCLEAR TECHNOLOGY

Award Date: 2009

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. Theodore Besmann
Energy and Nuclear Security

Corporate Partner(s):
General Atomics

External Funding Above Match:
$4.8 million

Research Focus: The production of biofuels and coal to liquid fuels using nuclear process heat for more efficient production and the reduction of wastes associated with recycling of used fuel, seeking more long term strategies to manage used fuel, recovery of energy value in used fuel, and eliminating concerns over proliferation associated with recycling used fuel.

NUCLEAR SCIENCE AND ENERGY

Award Date: 2008

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. Dan Gabriel Cacuci
Nuclear Power and Advanced Materials

Corporate Partner(s):
Duke Energy, Progress Energy, SCANA, Westinghouse

External Funding Above Match:
$6.6 million

Research Focus: Performance, efficiency, and maintenance issues at existing and future nuclear power plants using expertise modeling and simulation related to nuclear fuels and materials.

SMART GRID TECHNOLOGY

Award Date: 2013

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. Johan Enslin
Duke Energy Smart Grid Technology Chair

Corporate Partner(s):
Duke Energy

External Funding Above Match:
$739,331

Research Focus: Develop technology to better manage global electric grid systems.

SOLID OXIDE FUEL CELLS*

Award Date: 2006

State Award Amount: $3 million

University: USC

Endowed Chair(s):
USC is recruiting one endowed chair.

External Funding Above Match:
$55.1 million

Research Focus: Develop solid oxide fuel cells for use in large, high-power systems such as industrial sites and electricity generating stations as well as for mobile power for computers, cell phones, and other electronics.

STRATEGIC APPROACHES TO THE GENERATION OF ELECTRICITY (SAGE)*

Award Date: 2007

State Award Amount: $5 million

University: USC

Endowed Chair(s):
Dr. Jochen Lauterbach

External Funding Above Match:
$9.8 million

Research Focus: Developing, improving, and advancing technologies to enhance the environmental performance of electricity production. Other work focuses on converting CO2 to chemicals, fuel cell and hydrogen storage-related research, and chemical production from coal to biomass.

* Graduated Center

INFORMATION SCIENCE

CYBERINSTITUTE

Award Date: 2008

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting the *C. Tycho Howle Endowed Chair in Collaborative Computing Environments.*

Corporate Partner(s):
Omnibond Systems, LLC

External Funding Above Match:
$4.1 million

Research Focus: Connecting research and scholarship, particularly in the fields of human computer interaction, data storage, interpretation, and visualization to the commercial sector via strategic industrial partnerships. Conduct research in conjunction with the Clemson University Cyber-Institute.

DATA ANALYSIS, SIMULATION, IMAGING, AND VISUALIZATION

Award Date: 2010

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Wolfgang Dahmen
Williams-Hedberg-Hedberg Chair of Mathematics

External Funding Above Match:
$1.9 million

Research Focus: Develop technology for transforming data into knowledge concentrating on inline data processing, multi-sensor data acquisition, tissue modeling, atomic scale modeling, and bioimaging.

OPTOELECTRONICS*

Award Date: 2008

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Dr. Eric Johnson
PalmettoNet Endowed Chair in Optoelectronics

Corporate Partner(s):
Advanced Photonic Crystal, Tetramer Technologies

External Funding Above Match:
$3.8 million

Research Focus: Improving devices, systems, and protocols used in high-speed optical communications networks.

SUSTAINABLE DEVELOPMENT

Award Date: 2010

State Award Amount: $4 million

University: Clemson

Endowed Chair(s):
Dr. Amy Landis
Thomas F. Hash '69 Endowed Chair in Sustainable Development

External Funding Above Match:
$2.1 million

Research Focus: Developing new technologies to support real-time monitoring and management of natural and built environments through the Intelligent River™ Project. The Center has created a wireless sensor that can monitor and transmit environmental data in real time.

TOURISM AND ECONOMIC DEVELOPMENT*

Award Date: 2005

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Simon Hudson

Corporate Partner(s):
Rawle Murdy
US Travel Association (USTA)

External Funding Above Match:
$303,459

Research Focus: Tourism is a $17 billion industry in South Carolina. The Center conducts cutting-edge tourism and hospitality research initiatives that will improve South Carolina's competitiveness as a tourism destination.

INNOVATION AND COMMERCIALIZATION

Award Date: 2004

State Award Amount: $5 million

University: USC

Endowed Chair(s):
Dr. Laura B. Cardinal
Discovery and *Innovation*

Corporate Partner(s):
Fluor Foundation and Savanah River Nuclear Solutions LLC

External Funding Above Match:
$21.6 million

Research Focus: The innovation, commercialization, and new venture development of research in the SmartState Centers, leading to technology commercialization and transfer activities in collaboration with business organizations and public sector stakeholders.

* Graduated Center

PHARMACEUTICAL

CANCER DRUG DISCOVERY

Award Date: 2005

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. John LeMasters, MUSC
GlaxoSmithKline Distinguished Endowed Chair

Dr. Patrick Woster, MUSC
Medicinal Chemistry

Dr. Mark Hamann, MUSC
Charles & Carol Cooper Chair in Pharmacy

Dr. Mitzi Nagarkatti, USC
Structural Biology and *Pharmacy*

Corporate Partner(s):
GlaxoSmithKline

External Funding Above Match:
$17.5 million

Research Focus: Advanced biomedical screening technologies to identify disease mechanisms and targets, and also screening drug candidates. Structural biology for target analysis, chemical biology for designing drug candidates, and advanced biomedical screening technologies.

CANCER STEM CELL BIOLOGY AND THERAPY

Award Date: 2008

State Award Amount: $5 million

Universities: MUSC, Clemson

Endowed Chair(s):

Dr. Zihai Li, MUSC
Abney Endowed Chair Remembering Sally Abney Rose

Dr. Xue Zhong Yu, MUSC
Biomedical Engineering

External Funding Above Match:
$9.9 million

Research Focus: Developing new technologies for isolating, growing, and manipulating cancer stem cells. This will enable the Center to find ways to use adult stem cells from bone marrow or organs to treat cancer.

GASTROINTESTINAL CANCER DIAGNOSTICS

Award Date: 2005

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Carolyn Britten
Charles Westerfield Coker Distinguished Chair in Gastrointestinal Malignancy

MUSC is recruiting the *Grace E. DeWolff Endowed Chair in Medical Oncology.*

Corporate Partner(s):
Roche Carolina, Bank of America

External Funding Above Match:
$12.3 million

Research Focus: Clinical and translational gastrointestinal oncology and biomarker development and gastrointestinal (GI) malignancies. Bringing state-of-the-art translational medicine to all GI cancer patients in South Carolina, thereby decreasing the overall impact of cancer mortality and morbidity and closing disparity gaps throughout the state.

LIPIDOMICS, PATHOBIOLOGY AND THERAPY

Award Date: 2009

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. J. Alan Diehl
Lipidomics & Pathobiology

Dr. Besim Ogretmen
Lipidomics Drug Discovery

External Funding Above Match:
$26.8 million

Research Focus: Develop models for translational research and study of lipidomics and their pathobiology with an emphasis on cancer and inflammation.

MEDICATION SAFETY AND EFFICACY

Award Date: 2008

State Award Amount: $2 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Charles Bennett
Frank P. and Josie M. Fletcher Professor of Pharmacy

External Funding Above Match:
$4 million

Research Focus: Increasing drug safety and effectiveness, as well as decreasing medication errors by identifying the incidence and significance of adverse drug events.

TRANSLATIONAL CANCER THERAPEUTICS

Award Date: 2004

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Kenneth Tew, MUSC
John C. West Endowed Chair in Cancer Research

Dr. Igor Roninson, USC
Drug Efficacy

External Funding Above Match:
$21.3 million

Research Focus: Development of new approaches in cancer treatment, including the discovery and development of new drugs. Research also focuses on utilizing mouse models predisposed to cancer to study the impact of gene misregulation and therapeutic agents on tumor development, and the identification and inhibition of new cancer drug targets.

SMARTSTATE® PROFILE:
DR. STEPHEN DUNCAN

According to the American Liver Foundation, 17,000 adults and children are medically approved for liver transplants and waiting for donor organs. Six thousand liver transplants are performed each year and the number is rising. Meanwhile, 1,500 Americans die each year waiting for a donor.

What if people with potentially lethal liver diseases had non-transplant options? Could we avoid costly and not always effective liver transplants and improve patient outcomes? These are questions Dr. Stephen Duncan, the SmartState® Endowed Chair in Regenerative Medicine at the Medical University of South Carolina (MUSC) is working on answering.

Duncan is a pioneer in stem cell research who came to MUSC in 2015 from the Medical College of Wisconsin in Milwaukee. And while his research, which is funded in part by the National Institute of Diabetes, Digestive and Kidney Disease (NIDDKD), was making substantial progress, Duncan chose to accept the SmartState® Endowed Chair and also the chairmanship of MUSC Department of Regenerative Medicine and Cell Biology.

"I was interested in a leadership position and expanding the scope of my research in liver-related regenerative medicine. MUSC and the SmartState® Program provided the perfect opportunity," Duncan said. "I was also attracted to Charleston, the aesthetic beauty of the Lowcountry and the friendly people. It provides great balance to my life."

Not that he has much free time. Duncan completed his postdoctoral work in liver disease under the guidance of James Darnell at Rockefeller University, a leader in liver disease. While there, Duncan began exploring the use of embryonic stem cells and genetics in determining better treatment modalities for liver disease. Today, he is pioneering stem cell research and is at the forefront of the race to develop new technology to make liver cells.

"Ultimately, our goal is to use stem cell approaches to cure metabolic liver diseases that include a rare form of hypercholesterolemia. We're currently working on how to efficiently produce liver cells from stem cells in the laboratory. These reprogrammed cells from patients would then provide us with a target for drug testing," Duncan explained.

Duncan's research takes "patient-centered care" to new heights, using a patient's own cells to find a cure for their disease. The patient's stem cells are harvested from a urine sample or blood draw. Molecular techniques are applied to turn the sample into stem cells genetically identical to the person who provided them. Duncan and his team then replicate the patient's disease in the lab with the aim to identify better, non-surgical treatment options.

In the case of drug development, Duncan has successfully modeled several metabolic liver diseases by generating liver cells from patient-specific cells. He believes this has opened a new door into drug discovery that could yield important breakthroughs in the next five years or so.

"We want to help people with serious liver disease immediately rather than making them wait months or years for a liver transplant that may or may not work," Duncan said.

> *"The ability to produce patient-specific liver cells using the patient's own stem cells has opened doors that reveal a new way of studying metabolic liver disease that could revolutionize treatment of such disorders. Our long-term goal is to avoid liver transplants and secure better long-term outcomes for patients."*

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

STEPHEN DUNCAN, Ph.D.

Endowed Chair
SmartState® Center for Regenerative Medicine

SMARTSTATE® ENDOWED CHAIRS

The role of SmartState® Program Endowed Chairs is to serve as catalysts for the state's knowledge economy.

Sixty-six chairs of 85 approved chairs have been filled at Clemson, MUSC, and USC across 51 SmartState® Centers. The SmartState® Program welcomed 14 new endowed chairs this year: Dr. Laura B. Cardinal, Dr. Kenneth Catchpole, Dr. Christopher Cowan, Dr. Thomas DiSalvo, Dr. Johan Enslin, Dr. Julius Fridriksson, Dr. Jeremy Gilbert, Dr. Venkat Krovi, Dr. Laine Mears, Dr. Anand S. Mehta, Dr. Stephane Meystre, Dr. Mitzi Nagarkatti, Dr. Deepak Nihalani, and Dr. Betty Tsao.

ROBERT ADAMS
Stroke
MUSC

ROBERT F. BALDWIN
Urban Ecology and Restoration
Clemson

JOHN BALLATO
Optical Materials/ Photonics
Clemson

BRIAN BENICEWICZ
Polymer Nanocomposites
USC

CHARLES BENNETT
Medication Safety and Efficacy
USC

THEODORE BESMANN
General Atomics
USC

CAROLYN BRITTEN
Gastrointestinal Cancer Diagnostics
MUSC

JOHN BROOKS
Effectiveness Research in Orthopedics
USC

DAN GABRIEL CACUCI
Nuclear Science and Energy
USC

LAURA B. CARDINAL
Innovation and Commercialization
USC

MANUEL CASANOVA
Childhood Neurotherapeutics
USC

KENNETH CATCHPOLE
Health Facilities Design and Testing
MUSC

MARK CHIMOWITZ
Stroke
MUSC

CHRISTOPHER COWAN
Neurosciences
MUSC

WOLFGANG DAHMEN
Data Analysis Simulation Imaging and Visualization
USC

NANCY DEMORE
Tobacco-related Malignancies
MUSC

J. ALAN DIEHL
Lipidomics Pathobiology and Therapy
MUSC

THOMAS DISALVO
Molecular Proteomics in Cardiovascular Disease and Prevention
MUSC

RICHARD DRAKE
Proteomics
MUSC

STEPHEN A. DUNCAN
Regenerative Medicine
MUSC

JOHAN ENSLIN
Smart Grid Technology
Clemson

CAROL FEGHALI-BOSTWICK
Inflammation & Fibrosis Research
MUSC

ZORAN FILIPI
Automotive Design and Development
Clemson

JULIUS FRIDRIKSSON
SeniorSMART®
USC

JEREMY GILBERT
Regenerative Medicine
Clemson

MARK HAMANN
Cancer Drug Discovery
MUSC

JOSEPH HELPERN
Brain Imaging
MUSC

SIMON HUDSON
Tourism and Economic Development
USC

CHANITA HUGHES-HALPERT
Prostate Cancer Disparities
MUSC

ERIC JOHNSON
Optoelectronics
Clemson

ANJALI JOSEPH
Health Facilities Design and Testing
Clemson

VENKAT KROVI
Vehicle Electronic Systems Integration
Clemson

AMY LANDIS
Sustainable Development
Clemson

JOCHEN LAUTERBACH
Strategic Approaches to the Generation of Electricity (SAGE)
USC

JAMIE LEAD
Environmental Nanoscience and Risk
USC

JOHN LEMASTERS
Cancer Drug Discovery
MUSC

LES LENERT
Healthcare Quality
MUSC

SUE LEVKOFF
SeniorSMART®
USC

XIAOMING LI
Healthcare Quality
USC

ZIHAI LI
Cancer Stem Cell Biology and Therapy
MUSC

SHELDON E. LITWIN
Molecular Proteomics in Cardiovascular Disease and Prevention
MUSC

SCOTT MASON
Supply Chain Optimization and Logistics
Clemson

LAINE MEARS
Automotive Manufacturing
Clemson

ANAND S. MEHTA
Proteomics
MUSC

STEPHANE MEYSTRE
Translational Biomedical Informatics
MUSC

MARTIN MORAD
Regenerative Medicine
USC

GAVIN NAYLOR
Marine Genomics
MUSC

MITZI NAGARKATTI
Cancer Drug Discovery
USC

DEEPAK NIHALANI
Renal Disease Biomarkers
MUSC

JIHAD OBEID
Clinical Effectiveness and Patient Safety
MUSC

BESIM OGRETMEN
Lipidomics Pathobiology and Therapy
MUSC

JOHN REGALBUTO
Catalysis for Renewable Fuels
USC

BAERBEL ROHRER
Vision Science
MUSC

IGOR RONINSON
Translational Cancer Therapeutics
USC

CHRIS RORDEN
Brain Imaging
USC

JOHN SCHAEFER
Clinical Effectiveness and Patient Safety
MUSC

SOUVIK SEN
Stroke
USC

KENNETH TEW
Translational Cancer Therapeutics
MUSC

FRANK TRIEBER
Technology Center to Enhance Healthful Lifestyles
MUSC

BETTY TSAO
Inflammation and Fibrosis Research
MUSC

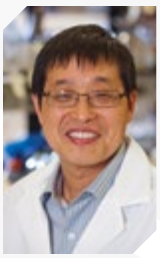
JEFFREY TWISS
Childhood Neurotherapeutics
USC

MAREK URBAN
Advanced Fiber Materials
Clemson

MICHAEL VAN TOOREN
Multifunctional Materials & Structures
USC

DELIA WEST
Technology Center to Enhance Healthful Lifestyles
USC

PATRICK WOSTER
Cancer Drug Discovery
MUSC



XUE ZHONG YU
Cancer Stem Cell Biology and Therapy
MUSC

SMARTSTATE® PROFILE:

DR. JULIUS FRIDRIKSSON

It is a concern of clinicians and patients alike; why some stroke victims suffer from aphasia, a condition that leaves them unable to speak, listen, read or write, but does not affect intelligence.

Also troubling is why aphasia is sometimes temporary, lasting a few days or weeks, while in other cases is permanent. Aphasia is of particular concern in South Carolina, a state with the seventh highest stroke-related death rate and half of stroke patients are under age 60.

The issue has interested SmartState® Chair Julius Fridriksson, who is also a distinguished professor in the University of South Carolina (USC) Arnold School of Public Health's Department of Communication Sciences and Disorders. Last March, Fridriksson received a five-year, $11.1-million grant from the National institute on Deafness and Other Communication Disorders, one of the largest grant awards in USC's history, to help solve the aphasia mystery. He and his co-investigators will use the grant to establish the Center for the Study of Aphasia Recovery, which will span four research sites, including the USC Arnold School of Public Health, working with USC's McCausland Center for Brain Imaging; the Medical University of South Carolina (MUSC), Johns Hopkins University, and the University of California Irvine (UCI).

Although technology for evaluating and treating stroke survivors has advanced significantly, the ability of clinicians to offer personalized prognosis and treatment plans for individual patients has remained stunted because factors such as age, gender, and brain fitness and how they impact rehabilitation outcomes are unknown.

"Clinicians have to end every appointment by telling the patient, 'everyone's different and I can only speculate on how you will recover. This is frustrating for everyone,'" Fridriksson explained. "I don't want to do that anymore. I know for certain that the patients and their families don't want to hear that anymore. They need something more concrete."

These unknowns and the uncertain future they cause can lead to anxiety and depression for stroke patients. Fridriksson hopes to identify the crucial factors that affect an individual's prognosis. One of the primary factors in predicting prognosis is brain fitness, an umbrella term that includes many different measures of brain integrity, such as residual cerebral blood flow, intactness of brain connections, and location and size of brain damage. Fridriksson and his co-investigators will also assess variables such as age, time-post stroke, gender, and neuropsychological status.

The answers, said Fridriksson, lie in two areas: detailed MRI images that show blood flow and functional activity of the brain and big data. All four sites, USC, MUSC, Johns Hopkins and UCI, will collect and analyze MRIs and data from hundred of stroke patients. Joining the project are Fridriksson's close collaborators and fellow SmartState® Chairs Chris Rorden, Neuroimaging, and Souvik Sen, Stroke. "Chris is known worldwide for his data analysis. He provides data analytics expertise that I don't have and we need for this study. Souvik brings stroke and neurology expertise. When completed, this will be the largest aphasia recovery study in the last several decades and, we hope our research findings will have national and international implications on stroke patients' treatment." ●

"Aphasia caused by stroke affects a person's ability to speak, listen, read or write, but doesn't affect intelligence. Currently, clinicians have a difficult time predicting which patients will be impacted or how severe or long-lasting the effects will be. With this new $11.1 million federal grant, we hope to better understand why this happens and improve recovery from stroke-induced communication impairment."

UNIVERSITY OF SOUTH CAROLINA

JULIUS FRIDRIKSSON, Ph.D.

SmartBRAIN™ Endowed Chair
SeniorSMART® Center

IN CLOSING

Elevating South Carolina: A Shared Effort, A Shared Success

The SmartState® Program would like to borrow a quote from Peter Drucker and give it a slight twist:

"Whenever you see a successful state, someone once made a courageous decision."

In preparing the 2015-2016 SmartState® Program annual report, we realized how many courageous decisions have been made since the program's founding in 2002 when the South Carolina General Assembly passed the enabling legislation. No state had ever done what South Carolina was about to do, which was use public-private partnerships to recruit and fund university-based endowed chairs to transform the state's economy.

The decision was risky. It was courageous. And it worked!

Fast-forward 14 years. In a June 2016 report released by WalletHub and reported in Forbes, South Carolina was ranked thirteenth in the nation in economic activity, well above North Carolina at twenty-second and just below Georgia at eleventh. WalletHub drew these conclusions looking at metrics ranging from GDP growth and business startup activity to venture-capital funding per-capita and percentage of jobs held by scientists and engineers. Each measure was weighted and divided into one of three categories: economic activity, economic health and innovation potential.

This ranking signaled something many in South Carolina already know: we are a state on the rise!

The SmartState® Program would like to thank everyone who has made courageous decisions—our lawmakers, our universities, endowed chairs, business leaders and the public. Your efforts have elevated South Carolina to new heights and new success.

SMARTSTATE®

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In accordance with S.C. Code of Laws §1-11-425, the following information is provided: Number of reports printed: 400. Cost per report: $6.31. Total printing cost: $2,523

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